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DR. V. FAYE MCNEILL

Assistant Professor
Department of Chemical Engineering
Columbia University

"Atmospheric Aerosols: Chemistry, Clouds, and Climate"

Atmospheric aerosol particles impact Earth's radiation balance, and therefore its climate, both directly by scattering and absorbing solar radiation and indirectly by influencing cloud albedo. By their direct and indirect effects on climate, aerosols provide a net negative radiative forcing that may be comparable in magnitude to the positive forcing by CO2. However, significant gaps in our scientific understanding of aerosol-related climate forcings have resulted in very large uncertainties in the estimates of their magnitudes.

Organic matter is a ubiquitous component of atmospheric aerosols, typically comprising 10 to 90% of fine aerosol mass. Inorganic aerosols may acquire an organic component via in situ interactions with volatile organic compounds (VOCs), a family of processes known as secondary organic aerosol (SOA) formation. SOA formation is one of the greatest sources of uncertainty in estimations of aerosol forcing on climate. Our recent work provides evidence that SOA formation may significantly change the climate properties of the seed aerosol [Shapiro et al., 2009; Sareen et al., 2010]. We have identified via laboratory studies that particle-phase chemical reactions of the □-dicarbonyl species glyoxal and methylglyoxal with ammonium salts may result in secondary products which absorb light in the UV and visible. We have also observed that methylglyoxal depresses surface tension in aqueous aerosol mimics by up to 45%. These observations have potentially significant implications for our understanding of the effects of secondary organic aerosol material (SOA) on climate, since a) SOA is typically treated as non-absorbing in climate models, and b) surface active SOA material may alter the ability of an aerosol particle to nucleate and grow into a cloud droplet.